Determination of the Kobayashi-Maskawa-Cabibbo matrix element V_{us} under various flavor-symmetry breaking models in hyperon semileptonic decays

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Abstract

We study the success to describe hyperon semileptonic decays of four models that incorporate second-order $SU(3)$ symmetry breaking corrections. The criteria to assess their success is by determining V_{us} in each of the three relevant hyperon semileptonic decays and comparing the values obtained with one another and also with the one that comes from K_{l3} decays. A strong dependence on the particular symmetry breaking model is observed. Values of V_{us} which do not agree with the one of K_{l3} are generally obtained. However, in the context of chiral perturbation theory, only the model whose corrections are $O(m_s)$ and $O(m_s^{3/2})$ is successful. Using its predictions for the f_1 form factors one can quote a value of V_{us} from this model, namely, $V_{us} = 0.2176 \pm 0.0026$, which is in excellent agreement with the K_{l3} one.

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I. INTRODUCTION

From the theoretical point of view, hyperon semileptonic decays (HSD) are considerably more complicated than pseudoscalar-meson semileptonic decays. The participation of vector and axial-vector currents in the former leads to the appearance of many more form factors. While in the latter not only less form factors appear, because only the vector current can participate, but also the theoretical approach to compute such form factors is under quite reasonable control [1]. These facts allow that the Kobayashi-Maskawa-Cabibbo matrix element V_{us} be more reliably determined in the decays $K^+ \to \pi^0 l^+ \nu_l$ and $K^0 \to \pi^- l^+ \nu_l$ than in HSD. An analysis of K_{l3} decays [1] yields $V_{us} = 0.2196 \pm 0.0023$. The inclusion of more refined $SU(2)$ symmetry-breaking corrections leads to [2]

$$V_{us} = 0.2188 \pm 0.0016\,. \tag{1}$$

It is difficult to assess the success of the many calculations of $SU(3)$ symmetry-breaking corrections to the form factors of HSD. Predictions that vary substantially from one another are obtained. An important selection of such calculations can be found in references [3–6]. These are refined calculations that incorporated second-order symmetry breaking corrections to the leading vector form factor f_1. However, a reliable knowledge of V_{us} provides an opportunity to establish some criteria to discriminate between the several such calculations. If one uses them to determine V_{us} from HSD, then –in addition to reproducing the experimental data reasonably well– the following two criteria must be satisfied:

(i) one must obtain a consistent value of V_{us} in the relevant HSD, and

(ii) this latter value of V_{us} must also be consistent with its value of K_{l3} decays, Eq. (1).

With the currently available experimental information the relevant HSD to determine V_{us} are $\Lambda \to pe\nu$, $\Sigma^- \to ne\nu$, and $\Xi^- \to \Lambda e\nu$ [7]. This information in the form of decay rates, angular correlations, and spin asymmetries is collected in Table I. An alternative set of experimental data is constituted by the rates and the measured g_1/f_1 ratios. However, this latter set is not as rich as the former and will not be used here.

In this paper we shall perform a detailed analysis of the success of the predictions of references [3–6] for HSD through the values obtained for V_{us}, as explained above. In Sec. II we shall briefly review the predictions of these references and we shall make the first determination of V_{us}. In Sec. III we shall study the effect upon V_{us} of the induced vector and axial-vector form factors f_2 and g_2, respectively. This study will give us a more precise determination of V_{us}. Sec. IV will be reserved for discussions and conclusions. Our main result will be that only the predictions of Ref. [6] satisfy criteria (i) and (ii), in accordance with the findings of a model independent analysis performed before [8].

II. A FIRST DETERMINATION OF V_{us}

We shall refer to the calculations of references [3–6] as Models I, II, III, and IV, respectively. Our interest in them arises from the fact that in each of them not only first order but second-order $SU(3)$ symmetry-breaking corrections to the leading vector form factor f_1 were calculated. In models I and III the corrections to the leading axial-vector form factor g_1 were also produced. The approaches and/or approximations used in going from one model

to another are quite different. In Model I a relativistic quark model was used. Model II made use of chiral perturbation and included corrections of $O(m_s)$. Model III relied on the non-relativistic quark and bag models and included both wave-function mismatch and center of mass corrections. A similar approach treating solely center of mass corrections was analized in Ref. [9]. Model IV followed the lines of Model II but it incorporated the more refined corrections of $O(m_s^{3/2})$. The corresponding predictions for f_1 are reproduced in Table II. They are displayed in the form of ratios $f_1/{f_1}^{SU(3)}$. The values of $g_1/{g_1}^{SU(3)}$ predicted by Models I and III are displayed in Table III. The symmetry limit values ${f_1}^{SU(3)}$ and ${g_1}^{SU(3)}$ correspond to the conserved vector current hypothesis (CVC) and the Cabibbo theory predictions, respectively. A review of this last can be found in Ref. [10].

For our analysis we shall include radiative corrections and the four-momentum transfer contributions of the form factors. The detailed expressions are given in Ref. [10]. None of the four models give the predictions for f_2 and g_2. In this section we shall assume for the several f_2 their CVC predictions and we shall keep each g_2 equal to zero, in accordance with the assumption of the absence of second-class currents. The other two induced form factors f_3 and g_3 can be safely ignored in the three decays we consider, because their contributions are proportional to the electron mass.

With this last information we can already make the first determination of V_{us} with Models I and III. The values obtained are given in Tables IV and V, respectively. We show in these tables the values of g_1 used, but this time normalized with respect to f_1. The effects of considering only center of mass corrections in Model III, as discussed in Ref. [9], have been displayed in the entries within parentheses of Table V. In the case of Models II and IV we do not have the corresponding predictions for the g_1's. We shall leave each one as a free parameter and then the results of Tables VI and VII are obtained. In order to make a comparison on an equal footing of the four models we also leave the g_1's as free parameters with Models I and III. Tables VIII and IX are thus obtained.

Let us now look into the results obtained. The f_1 and g_1 form factors predicted by Models I and III lead to values of V_{us} that differ from one decay to another by more than three standard deviations, as can be seen in Tables IV and V. That is, criterion (i) above is not satisfied. In contrast, Models II and IV do lead to values of V_{us} in Tables VI and VII that in each model are consistent with one another within a little bit more than one standard deviation. When the g_1's are free parameters the new determinations of V_{us} of Models I and III given in Tables VIII and IX become consistent in each model, too. The criterion (i) is satisfied by the four models when the g_1's are allowed to be free parameters. The calculated g_1's of Models I and III seem to be ruled out by criterion (i). This is also confirmed by the high χ^2 obtained when the g_1's are fixed. However, in Model III when only center of mass corrections are considered the χ^2 of $\Lambda \rightarrow pe\nu$ is remarkably lowered although the value of V_{us} obtained is increased with respect to the case when the wave-function mismatch corrections are included.

Concerning criterion (ii), we see that Models I, II, and III give values of V_{us} that are systematically higher than the K_{l3} value of Eq. (1) close to three standard deviations in some cases or more than three in other cases. In contrast, Model IV gives systematically values of V_{us} that are lower than Eq. (1). These values, however, are pretty close to Eq. (1).

The high χ^2 in $\Lambda \rightarrow pe\nu$ in Tables IV and V is due mainly to $\alpha_{e\nu}$ and α_ν, whereas in Tables VI– IX it comes mainly from α_e and α_ν. In the case of $\Sigma^- \rightarrow ne\nu$ the χ^2 is also high

and comes mainly from α_ν and α_B. Even when the g_1's are used as free parameters, despite the appreciable lowering of χ^2, a still rather high χ^2 remains in $\Lambda \to pe\nu$ and $\Sigma^- \to ne\nu$.

Before drawing conclusions, it is important to consider the effect the induced form factors f_2 and g_2 have upon the determination of V_{us} and χ^2. This we do in the next section.

III. EFFECT OF THE INDUCED VECTOR AND AXIAL-VECTOR FORM FACTORS

None of the four models under consideration here produced predictions for f_2 and g_2. Nevertheless, it is necessary to study their relevance in determining V_{us}. We shall allow them to be free parameters, since inasmuch as they help reduce χ^2 we may expect that experimental data, which certainly know of symmetry breaking corrections, will force them to move into the correct direction.

The CVC contributions of f_2 are already first-order symmetry breaking contributions to the experimental observables of Table I. Accordingly, one should only consider first-order symmetry breaking of such CVC predictions in order to take into account the second-order contributions of the f_2. It is reasonable to allow the f_2's to vary only up to 20% around the CVC values. This we shall do in steps, first by changing the f_2's by $\pm 10\%$ and keeping them fixed while redoing the fits of the previous section and next by changing them by $\pm 20\%$ and repeating the whole procedure.

The results of this analysis are that practically no observable effects upon the values of V_{us} are seen to occur. Only the fourth digits are changed, without even affecting third digits by rounding up. There is no need to produce new tables with such negligible changes.

Due to the absence of second-class currents, the g_2 are all zero in the symmetry limit. They will be rendered non-zero by $SU(3)$ symmetry breaking. As in the case of the f_2, the first-order corrections to them will amount to second-order contributions to the observables. We shall introduce fixed values of the g_2's first of ± 0.10 and next by ± 0.20 and redo all the fits of Sec. II. These changes seem to be of reasonable size according to the estimations of Refs. [11] and [12]. The g_2's do lead observable changes.

Models I and III with f_1 and g_1 fixed at their predictions give values of V_{us} in $\Lambda \to pe\nu$ that come closer to Eq. (1), but still with high χ^2 –meaning that the corresponding experimental data are not satisfactorily reproduced. Also the dispersion of the values of V_{us} from the three decays, although somewhat mitigated is not corrected either. All this is collected in Tables X and XI. The effect of dropping the wave-function mismatch corrections of Model III is displayed in the entries within parentheses of Table XI. Again an appreciable lowering of χ^2 is seen in $\Lambda \to pe\nu$ and also in $\Sigma^- \to ne\nu$, but at the expense of increasing V_{us} with respect to the corresponding values of V_{us} when such corrections are included.

When the g_1's are allowed to vary then Models I and III improve their agreement with experiment, the corresponding χ^2's are noticeably reduced. This can be seen in Tables XII and XIII. But the values of V_{us} are increased to the extent that none is any longer compatible with Eq. (1). This situation repeats itself for Model II in Table XIV. In contrast, the values of V_{us} obtained with Model IV are fairly stable with respect to changes of g_2. Actually, as seen in Table XV they tend to increase with respect to the corresponding entries of Table VII, which is in the right direction towards Eq. (1).

Concerning the agreement with experiment we observe that a further lowering to an acceptable value of χ^2 is obtained in $\Sigma^- \to ne\nu$ as an effect of a non-zero g_2. However, this lowering is not observed in the χ^2 of $\Lambda \to pe\nu$, which remains at around 10 through Tables XII – XV. This effect may be due to some experimental inconsistency of the value of α_ν, which contributes 7 to χ^2, with the other asymmetries. If this α_ν is left out the same V_{us} is obtained along with practically the same error bars. For example, with the f_1 of Model III and with variable g_1/f_1, one obtains $V_{us} = 0.2220 \pm 0.0035, 0.2261 \pm 0.0035$, and 0.2302 ± 0.0035 for $\Delta g_2 = -0.20, 0.0$, and $+0.20$, respectively. The corresponding χ^2's are 4.30, 4.1, and 4.0, which represents a considerable reduction with respect to the corresponding χ^2's in Table XIII; these new χ^2's indicate a very good agreement with other four observables in $\Lambda \to pe\nu$. The same pattern repeats itself when α_ν is left out in the comparison of the other models. In view of this situation we shall keep the several tables as they are. The high χ^2 of $\Lambda \to pe\nu$ should serve as a remainder that some problem exists in this decay. It is not idle to insist that new measurements in this decay should be most welcome.

The combined effect of simultaneous changes of f_2 and g_2 leads to the same results of Tables X – XV, except for minor changes in the fourth digits of the several values of V_{us}. Again there is no need to produce tables to show this. Let us pass to the last section.

IV. DISCUSSION AND CONCLUSIONS

Throughout our study, we notice that the values obtained for V_{us} are very model dependent. We also notice that, except for one model, the values of V_{us} are inconsistent with each other within the same model. These observations render inadmissible to quote a consistent average value from HSD.

However, since the dispersion of the values of V_{us} in each of the three decays is mitigated in all the models when one allows the g_1 to be free parameters, one may quote an average value of the V_{us} obtained with each model by selecting the appropriate sign of Δg_2 that lowers most the corresponding χ^2. That is, we accept that criterion (i) is more or less satisfied by each model. These averages are collected in Table XVI. We have also included there the averages of the case $\Delta g_2 = 0$. This last table allows us to better appreciate how criterion (ii) is satisfied or not.

Looking at the averages obtained for V_{us} with each model, one readily sees that Models I, II, and III are far from satisfying criterion (ii), while Model IV satisfies it remarkably well. From this point of view, it becomes very clear that the criteria discussed in the introduction indeed serve as quite stringent discriminating tools between different models and/or approximations. Our main conclusion in this regard is that of the four models that provide second-order symmetry breaking corrections to the f_1's only Model IV of Ref. [6] is acceptable.

This conclusion allows us to quote the best value of V_{us} that can be obtained from Model IV, namely,

$$V_{us} = 0.2176 \pm 0.0026 \,. \tag{2}$$

Since this value is statistically in very good agreement with the K_{l3} one of Eq. (1), we can average both and get

$$V_{us}^{\mathrm{AV}} = 0.2185 \pm 0.0014\,. \qquad (3)$$

The determination of V_{us} in Eq. (2) is quite acceptable in the light of the model independent analysis of Ref. [8]. Although we have committed ourselves with the predictions of Model IV for the f_1's, the rest of the form factors was dealt with in a model-independent fashion.

This last remark brings us to our closing comments. One cannot yet consider the theoretical issues as closed. It is most important that within the same Model IV used to calculate the f_1's the other relevant form factors be also computed. The values displayed for these form factors in Tables VII and XV may provide useful guidance for this enterprise. Our analysis of Sec. III shows that detailed values of the f_2's are not relevant and thus these HSD do not provide useful guidance for their calculation. It should be found elsewhere. Also, as pointed out in Ref. [13] a viable model of $SU(3)$ breaking should be able to predict the $\Delta S = 0$ modes, $\Sigma^{\pm} \to \Lambda e\nu$. Only if the predictions for $\Delta S = 0$ and $\Delta S \neq 0$ decays are simultaneously correct should one consider Model IV completely successful.

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TABLES

TABLE I. Experimental data for the three relevant HSD. The units of R are 10^6 s^{-1}.

	$\Lambda \to pe\nu$	$\Sigma^- \to ne\nu$	$\Xi^- \to \Lambda e\nu$
R	3.169 ± 0.058	6.876 ± 0.235	3.36 ± 0.19
$\alpha_{e\nu}$	-0.019 ± 0.013	0.347 ± 0.024	0.53 ± 0.10
α_e	0.125 ± 0.066	-0.519 ± 0.104	
α_ν	0.821 ± 0.060	-0.230 ± 0.061	
α_B	-0.508 ± 0.065	0.509 ± 0.102	
A			0.62 ± 0.10
g_1/f_1	0.718 ± 0.015	-0.340 ± 0.017	0.25 ± 0.05

TABLE II. $SU(3)$ breaking for f_1. The values correspond to the ratio $f_1/{f_1}^{\mathrm{SU(3)}}$.

Decay	Model I	Model II	Model III	Model IV
$\Lambda \to pe\nu$	0.976	0.943	0.987	1.024
$\Sigma^- \to ne\nu$	0.975	0.987	0.987	1.100
$\Xi^- \to \Lambda e\nu$	0.976	0.957	0.987	1.059

TABLE III. SU(3) breaking for g_1. The values correspond to the ratio $g_1/{g_1}^{\mathrm{SU(3)}}$. In parentheses, the breaking pattern of Model III including only center of mass corrections is given.

Decay	Model I	Model III
$\Lambda \to pe\nu$	1.072	1.050 (0.9720)
$\Sigma^- \to ne\nu$	1.056	1.040 (0.9628)
$\Xi^- \to \Lambda e\nu$	1.072	1.003 (0.9287)

TABLE IV. Values of V_{us} within the SB proposed by Model I. Both breaking patterns for f_1 and g_1 were used.

Decay	V_{us}	g_1/f_1	χ^2
$\Lambda \to pe\nu$	0.2133 ± 0.0020	0.8019	38.54
$\Sigma^- \to ne\nu$	0.2318 ± 0.0040	-0.3529	8.95
$\Xi^- \to \Lambda e\nu$	0.2434 ± 0.0068	0.2221	1.40

TABLE V. Values of V_{us} within the SB proposed by Model III. Both breaking patterns for f_1 and g_1 were used. In parentheses, below each entry, the corresponding values of V_{us}, g_1/f_1, and χ^2 considering only center of mass corrections are given.

Decay	V_{us}	g_1/f_1	χ^2
$\Lambda \to pe\nu$	0.2153 ± 0.0020	0.7767	25.43
	(0.2258 ± 0.0021)	(0.7190)	(10.85)
$\Sigma^- \to ne\nu$	0.2307 ± 0.0040	-0.3433	7.92
	(0.2351 ± 0.0041)	(-0.3178)	(8.89)
$\Xi^- \to \Lambda e\nu$	0.2429 ± 0.0068	0.2055	2.42
	(0.2449 ± 0.0069)	(0.1903)	(3.62)

TABLE VI. Values of V_{us} within the SB proposed by Model II, with g_1 as free parameter.

Decay	V_{us}	g_1	g_1/f_1	χ^2
$\Lambda \to pe\nu$	0.2372 ± 0.0037	-0.8250	0.7142	10.79
$\Sigma^- \to ne\nu$	0.2320 ± 0.0049	0.3312	-0.3356	7.70
$\Xi^- \to \Lambda e\nu$	0.2396 ± 0.0108	0.3264	0.2784	6×10^{-3}

TABLE VII. Values of V_{us} within the SB proposed by Model IV, with g_1 as free parameter.

Decay	V_{us}	g_1	g_1/f_1	χ^2
$\Lambda \to pe\nu$	0.2183 ± 0.0034	-0.8974	0.7155	10.77
$\Sigma^- \to ne\nu$	0.2082 ± 0.0044	0.3694	-0.3358	6.73
$\Xi^- \to \Lambda e\nu$	0.2165 ± 0.0098	0.3611	0.2784	6×10^{-3}

TABLE VIII. Values of V_{us} within the SB proposed by Model I, with g_1 as free parameter.

Decay	V_{us}	g_1	g_1/f_1	χ^2
$\Lambda \to pe\nu$	0.2291 ± 0.0036	-0.8545	0.7148	10.78
$\Sigma^- \to ne\nu$	0.2349 ± 0.0049	0.3271	-0.3355	7.82
$\Xi^- \to \Lambda e\nu$	0.2349 ± 0.0106	0.3328	0.2784	6×10^{-3}

TABLE IX. Values of V_{us} within the SB proposed by Model III, with g_1 as free parameter.

Decay	V_{us}	g_1	g_1/f_1	χ^2
$\Lambda \to pe\nu$	0.2265 ± 0.0035	-0.8643	0.7149	10.78
$\Sigma^- \to ne\nu$	0.2320 ± 0.0049	0.3312	-0.3356	7.70
$\Xi^- \to \Lambda e\nu$	0.2323 ± 0.0105	0.3366	0.2784	6×10^{-3}

TABLE X. Values of V_{us} within the SB proposed by Model I. f_1 and g_1 are fixed. g_2 are non-zero.

Δg_2	-0.20		-0.10		$+0.10$		$+0.20$	
Decay	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2
$\Lambda \to pe\nu$	0.2163 ± 0.0020	19.7	0.2148 ± 0.0020	27.7	0.2118 ± 0.0019	52.1	0.2103 ± 0.0019	68.1
$\Sigma^- \to ne\nu$	0.2266 ± 0.0039	19.9	0.2292 ± 0.0040	12.2	0.2343 ± 0.0040	9.9	0.2368 ± 0.0041	15.0
$\Xi^- \to \Lambda e\nu$	0.2409 ± 0.0068	0.8	0.2421 ± 0.0068	1.0	0.2445 ± 0.0069	1.8	0.2457 ± 0.0069	2.3

TABLE XI. Values of V_{us} within the SB proposed by Model III. f_1 and g_1 are fixed. g_2 are non-zero. In parentheses, below each entry, the corresponding values of V_{us} and χ^2 considering only center of mass corrections are given.

Δg_2	-0.20		-0.10		$+0.10$		$+0.20$	
Decay	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2
$\Lambda \to pe\nu$	0.2183 ± 0.0020	13.4	0.2168 ± 0.0020	18.0	0.2138 ± 0.0020	35.7	0.2123 ± 0.0020	48.7
	(0.2290 ± 0.0021)	(17.0)	(0.2274 ± 0.0021)	(12.2)	(0.2241 ± 0.0021)	(12.8)	(0.2225 ± 0.0020)	(17.9)
$\Sigma^- \to ne\nu$	0.2256 ± 0.0039	15.2	0.2282 ± 0.0039	9.5	0.2331 ± 0.0040	10.5	0.2355 ± 0.0041	16.9
	(0.2301 ± 0.0040)	(7.2)	(0.2327 ± 0.0040)	(6.0)	(0.2375 ± 0.0041)	(15.6)	(0.2398 ± 0.0041)	(25.9)
$\Xi^- \to \Lambda e\nu$	0.2406 ± 0.0068	1.5	0.2418 ± 0.0068	1.9	0.2440 ± 0.0069	3.0	0.2450 ± 0.0069	3.6
	(0.2427 ± 0.0068)	(2.5)	(0.2438 ± 0.0069)	(3.0)	(0.2459 ± 0.0069)	(4.3)	(0.2469 ± 0.0069)	(5.0)

TABLE XII. Values of V_{us} within the SB proposed by Model I. The g_1 are free and g_2 are non-zero. In parentheses, below the entries for V_{us}, the corresponding g_1 are also given.

Δg_2	-0.20		-0.10		$+0.10$		$+0.20$	
Decay	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2
$\Lambda \to pe\nu$	0.2248 ± 0.0036	11.6	0.2270 ± 0.0036	11.2	0.2312 ± 0.0036	10.4	0.2333 ± 0.0036	10.0
	(-0.9025)		(-0.8784)		(-0.8308)		(-0.8075)	
$\Sigma^- \to ne\nu$	0.2377 ± 0.0049	4.4	0.2364 ± 0.0049	6.0	0.2333 ± 0.0050	9.8	0.2316 ± 0.0050	12.0
	(0.2835)		(0.3051)		(0.3496)		(0.3726)	
$\Xi^- \to \Lambda e\nu$	0.2349 ± 0.0104	0.0	0.2349 ± 0.0105	0.0	0.2349 ± 0.0108	0.0	0.2349 ± 0.0109	0.0
	(0.3123)		(0.3226)		(0.3431)		(0.3534)	

TABLE XIII. Values of V_{us} within the SB proposed by Model III. The g_1 are free and the g_2 are non-zero. In parentheses, below the entries for V_{us}, the corresponding g_1 are also given.

Δg_2	-0.20		-0.10		$+0.10$		$+0.20$	
Decay	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2
$\Lambda \to pe\nu$	0.2223 ± 0.0035	11.6	0.2244 ± 0.0036	11.2	0.2286 ± 0.0035	10.4	0.2307 ± 0.0035	10.0
	(-0.9123)		(-0.8882)		(-0.8407)		(-0.8173)	
$\Sigma^- \to ne\nu$	0.2348 ± 0.0048	4.4	0.2335 ± 0.0049	5.9	0.2305 ± 0.0049	9.7	0.2288 ± 0.0049	11.8
	(0.2876)		(0.3092)		(0.3537)		(0.3767)	
$\Xi^- \to \Lambda e\nu$	0.2323 ± 0.0103	0.0	0.2323 ± 0.0104	0.0	0.2322 ± 0.0106	0.0	0.2322 ± 0.0108	0.0
	(0.3161)		(0.3263)		(0.3468)		(0.3571)	

TABLE XIV. Values of V_{us} within the SB proposed by Model II. The g_1 are free and the g_2 are non-zero In parentheses, below the entries for V_{us}, the corresponding g_1 are also given.

Δg_2	-0.20		-0.10		$+0.10$		$+0.20$	
Decay	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2
$\Lambda \to pe\nu$	0.2325 ± 0.0037	11.6	0.2349 ± 0.0037	11.2	0.2394 ± 0.0037	10.4	0.2417 ± 0.0037	9.9
	(-0.8730)		(-0.8489)		(-0.8013)		(-0.7780)	
$\Sigma^- \to ne\nu$	0.2348 ± 0.0048	4.4	0.2335 ± 0.0049	5.9	0.2305 ± 0.0049	9.7	0.2288 ± 0.0049	11.8
	(0.2876)		(0.3092)		(0.3537)		(0.3767)	
$\Xi^- \to \Lambda e\nu$	0.2396 ± 0.0106	0.0	0.2396 ± 0.0107	0.0	0.2395 ± 0.0110	0.0	0.2395 ± 0.0111	0.0
	(0.3059)		(0.3162)		(0.3366)		(0.3469)	

TABLE XV. Values of V_{us} within the SB proposed by Model IV. The g_1 are free and the g_2 are non-zero In parentheses, below the entries for V_{us}, the corresponding g_1 is also given.

Δg_2	-0.20		-0.10		$+0.10$		$+0.20$	
Decay	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2	V_{us}	χ^2
$\Lambda \to pe\nu$	0.2144 ± 0.0034	11.5	0.2164 ± 0.0034	11.2	0.2200 ± 0.0037	10.4	0.2222 ± 0.0034	10.0
	(-0.9454)		(-0.9212)		(-0.8748)		(-0.8503)	
$\Sigma^- \to ne\nu$	0.2104 ± 0.0043	3.9	0.2093 ± 0.0044	5.2	0.2070 ± 0.0044	8.4	0.2056 ± 0.0044	10.2
	(0.3258)		(0.3474)		(0.3919)		(0.4147)	
$\Xi^- \to \Lambda e\nu$	0.2165 ± 0.0096	0.0	0.2165 ± 0.0097	0.0	0.2165 ± 0.0099	0.0	0.2164 ± 0.0100	0.0
	(0.3406)		(0.3508)		(0.3714)		(0.3816)	

TABLE XVI. Values of V_{us} obtained within different $SU(3)$ SB models with changes in g_2. The rates and angular coefficients were used.

Δg_2	Model I	Model II	Model III	Model IV
$= 0$	0.2314 ± 0.0028	0.2356 ± 0.0028	0.2286 ± 0.0027	0.2147 ± 0.0026
$\neq 0$	0.2348 ± 0.0028	0.2392 ± 0.0028	0.2321 ± 0.0027	0.2176 ± 0.0026